CLAIMS

1. A film forming apparatus for forming a metal oxide film on a surface of a target process object, comprising:

a process vessel;

a mounting table which is accommodated in said process vessel and on which said target process object is to be mounted;

material supply means for supplying a vaporized metal oxide film material into said process vessel;

alcohol supply means for supplying a vaporized alcohol into said process vessel; and

a vacuum evacuation system for vacuum-evacuating said process vessel.

2. An apparatus according to claim 1, wherein said material supply means and said alcohol supply means mix the vaporized metal oxide film material with the vaporized alcohol and supply the mixture to said process vessel.

3. An apparatus according to claim 1, wherein said material supply means and said alcohol supply means independently supply the metal oxide film material and the vaporized alcohol to said process vessel.

4. An apparatus according to claim 1, wherein the metal oxide film material is a metallic alkoxide.

5. An apparatus according to claim 1, wherein said metal oxide film is formed of one material selected from

the group consisting of tantalum oxide, titanium oxide, zirconium oxide, barium oxide, and strontium oxide.

6. An apparatus according to claim 1, wherein said process vessel incorporates an alcohol decomposition catalyst for promoting decomposition of the alcohol.

7. An apparatus according to claim 6, wherein the alcohol decomposition catalyst is arranged above said mounting table.

8. An apparatus according to claim 6, wherein the alcohol decomposition catalyst consists of a metal oxide.

9. An apparatus according to claim 1, further comprising a modification process unit for modifying said metal oxide film formed on said surface of said target process object.

10. An apparatus according to claim 9, wherein said modification process unit comprises another process vessel, a mounting table which is accommodated in said another process vessel and on which said target process object is to be mounted, process gas supply means for supplying a process gas containing at least one of oxygen, ozone, and N_2O gas into said another process vessel, active oxygen generation means for generating active oxygen atoms from the process gas in said another process vessel, and a vacuum evacuation system for vacuum-evacuating said another process vessel.

11. An apparatus according to claim 10, wherein

said active oxygen generation means is one of UV irradiation means, plasma generation means, and target process object heating means.

12. An apparatus according to claim 10, further comprising a common transfer chamber for commonly connecting said process vessel in which said metal oxide film is formed on said target process object and said another process vessel of said modification process unit for modifying said metal oxide film.

13. A film modifying apparatus for modifying a metal oxide film on a target process object, comprising:

a process vessel;

a mounting table which is accommodated in said process vessel and on which said target process object is mounted;

process gas supply means for supplying a process gas containing at least one of oxygen, ozone, and N_2O gas into said process vessel;

active oxygen generation means for generating active oxygen atoms from the process gas in an atmosphere of said process vessel; and

a vacuum evacuation system for vacuum-evacuating said process vessel.

14. An apparatus according to claim 13, further comprising mounting table heating means for heating said mounting table.

15. An apparatus according to claim 13, wherein

said active oxygen generation means is UV irradiation means for irradiating a UV ray in the atmosphere in said process vessel to generate the active oxygen atoms.

16. An apparatus according to claim 15, wherein said UV irradiation means comprises a mercury-sealed lamp in which mercury is sealed, microwave generation means for applying a microwave to said mercury-sealed lamp to generate the UV ray, and a reflecting mirror for condensing the generated UV ray and uniformly irradiating the UV ray on said target process object.

17. An apparatus according to claim 15, wherein said UV irradiation means is constituted by a plurality of UV lamps substantially arrayed in parallel to oppose a surface of said mounting table.

18. An apparatus according to claim 15, wherein said process gas supply means has a shower head arranged between said UV irradiation means and said mounting table, said shower head being constituted by combining a plurality of gas injection pipes with injection holes.

19. An apparatus according to claim 18, wherein said plurality of gas injection pipes are combined into a matrix shape.

20. An apparatus according to claim 18, wherein a projection area of said plurality of gas injection pipes with respect to a surface of said mounting table is smaller than 20% of a surface area of said target process object.

21. An apparatus according to claim 13, wherein said active oxygen generation means is plasma generation means for applying a microwave or a high-frequency field to the atmosphere in said process vessel to generate a plasma, thereby generating the active oxygen atoms from the process gas.

22. An apparatus according to claim 21, wherein said process gas supply means has a shower head arranged between said plasma generation means and said mounting table, said shower head being constituted by combining a plurality of gas injection pipes with injection holes.

23. An apparatus according to claim 22, wherein said plurality of gas injection pipes are combined into a matrix shape.

24. An apparatus according to claim 22, wherein a projection area of said plurality of gas injection pipes with respect to a surface of said mounting table is smaller than 20% of a surface area of said target process object.

25. An apparatus according to claim 13, wherein said process gas supply means has a container-shaped lid with a lower open end portion to cover an upper surface of said mounting table, an introduction header unit having a lot of injection holes is formed on one side of said lid, and a delivery header unit having a delivery port is formed on the other side such that a gas flow is formed in a horizontal direction in said lid.

26. An apparatus according to claim 25, wherein said lid and said mounting table can be made close to or separated relative to each other in a vertical direction.

27. An apparatus according to claim 13, wherein said active oxygen generation means is heating means for heating said target process object within a range of 400°C to 850°C.

28. An apparatus according to claim 27, wherein said heating means is constituted by a plurality of heating lamps arranged under said mounting table.

29. An apparatus according to any one of claims 27 and 28, further comprising a cooling jacket arranged in a side wall of said process vessel to cool said side wall to a temperature lower than a thermal decomposition temperature of ozone.

30. An apparatus according to claim 13, further comprising a film formation process unit for forming said metal oxide film on a surface of said target process object.

31. An apparatus according to claim 30, wherein said film formation process unit comprises another process vessel, a mounting table which is accommodated in said another process vessel and on which said target process object is to be mounted, material supply means for supplying a vaporized metal oxide film material into said another process vessel, alcohol supply means for

supplying a vaporized alcohol into said another process vessel, and a vacuum evacuation system for vacuum-evacuating said another process vessel.

32. An apparatus according to claim 31, further comprising a common transfer chamber for commonly connecting said process vessel for forming said metal oxide film on said target process object and said another process vessel of a modification process unit for modifying said metal oxide film.

33. A film forming/modifying apparatus comprising:

a film formation process unit for forming a metal oxide film on a target process object in a vacuum atmosphere in which a vaporized metal oxide film material and a vaporized alcohol exist;

a modification process unit for exposing said metal oxide film to active oxygen atoms in the vacuum atmosphere, thereby modifying said metal oxide film; and

a common transfer chamber commonly coupled to said film formation process unit and said modification process unit to transfer said target process object between said film formation process unit and said modification process unit while keeping the vacuum state.

34. An apparatus according to claim 33, further comprising a turnable and flexible transfer arm mechanism arranged in said common transfer chamber to hold and convey said target process object.

35. An apparatus according to claim 33, further comprising a cassette accommodation chamber capable of being vacuum-evacuated, said cassette accommodation chamber being coupled to said common transfer chamber and accommodating a cassette capable of storing a plurality of target process objects.

36. An apparatus according to claim 33, said film formation process unit comprises a process vessel, a mounting table which is accommodated in said process vessel and on which said target process object is to be mounted, material supply means for supplying a vaporized metal oxide film material into said process vessel, alcohol supply means for supplying a vaporized alcohol into said process vessel, and a vacuum evacuation system for vacuum-evacuating said process vessel.

37. An apparatus according to claim 36, wherein said process vessel of said film formation process unit incorporates an alcohol decomposition catalyst for promoting decomposition of the alcohol.

38. An apparatus according to claim 37, wherein the alcohol decomposition catalyst is arranged above said mounting table.

39. An apparatus according to claim 37, wherein the alcohol decomposition catalyst consists of a metal oxide.

40. An apparatus according to claim 33, wherein said modification process unit comprises a process

vessel, a mounting table which is accommodated in said process vessel and on which said target process object is to be mounted, process gas supply means for supplying a process gas containing one of oxygen, ozone, and N_2O gas into said process vessel, active oxygen generation means for generating active oxygen atoms from the process gas in said process vessel, and a vacuum evacuation system for vacuum-evacuating said process vessel.

41. An apparatus according to claim 40, wherein said active oxygen generation means is one of UV irradiation means, plasma generation means, and target process object heating means.

42. A method of forming a metal oxide film on a surface of a target process object in a process vessel set in a vacuum state, comprising the step of forming said metal oxide film in a vacuum atmosphere containing a metal oxide film material and an alcohol.

43. A method according to claim 42, wherein the metal oxide film material and the alcohol are vaporized and supplied into said process vessel through different supply means.

44. A method according to claim 42, wherein the metal oxide film material and the alcohol are vaporized and mixed with each other, and the liquid mixture is vaporized and thereafter supplied into said process vessel.

45. A method according to claim 42, wherein a process temperature of said target process object is set within a range of 250°C to 450°C, and a content of the alcohol is set within a range of 0.1 wt.% to 20 wt.%.

46. A method according to claim 42, wherein the metal oxide film material is a metallic alkoxide.

47. A method according to claim 42, wherein said metal oxide film is formed of at least one material selected from the group consisting of tantalum oxide, titanium oxide, zirconium oxide, barium oxide, and strontium oxide.

48. A method according to claim 42, wherein decomposition of the alcohol is promoted by an alcohol decomposition catalyst.

49. A method according to any one of claims 42 and 48, wherein said metal oxide film itself has an alcohol decomposition catalyst function of promoting decomposition of the alcohol.

50. A method of modifying a metal oxide film formed on a surface of a target process object, comprising the steps of generating active oxygen atoms from a process gas containing at least one of oxygen, ozone, and N_2O gas in a vacuum atmosphere, and modifying said metal oxide film on said surface of said target process object by the active oxygen atoms.

51. A method according to claim 50, wherein the active oxygen atoms are generated from the process gas

by irradiating a UV ray on the process gas.

52. A method according to claim 50, further comprising applying a microwave or a high-frequency field to generate a plasma, thereby generating the active oxygen atoms from the process gas, and modifying the metal oxide film on said surface of said target process object by the active oxygen atoms.

53. A method according to claim 50, wherein an additive gas containing at least N_2 gas is mixed into the process gas.

54. A method according to claim 50, wherein a pressure of the vacuum atmosphere is set within a range of 1 to 600 Torr.

55. A method according to claim 50, wherein a temperature of said target process object is set within a range of 320°C to 700°C.

56. A method according to claim 50, said metal oxide film is formed of one material selected from the group consisting of tantalum oxide, titanium oxide, zirconium oxide, barium oxide, and strontium oxide.

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